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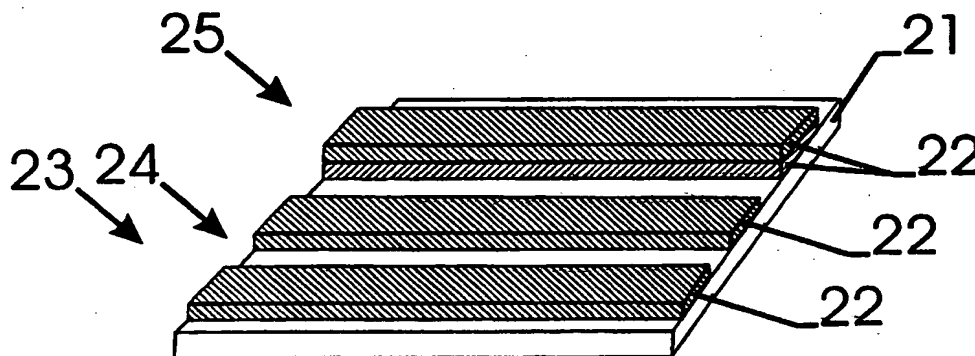
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(54) Title: **GAS BURNER MEMBRANE**



(57) Abstract: A gas burner membrane is provided. The membrane comprises a textile woven, braided or knitted fabric. This membrane further comprises different combustion zones on its burner surface. A method to provide such gas burner membrane is described.

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**GAS BURNER MEMBRANE****Field of the invention.**

5       The present invention relates to a gas burner membrane and a method to provide such.

**Background of the invention.**

10       Gas burner membranes out of sintered metal fiber mats and comprising different combustion zones is known from US5439372.

WO9704152 describes a method to provide a gas burner membrane out of metal fibers.

15       It is generally known that sintered metal fiber mats are stiff and therefor are difficult to bend or shape into a burner surface, other than flat. Moreover, during combustion, the sintered mats expand and tend to lift up when they are fixed to the burner housing.

20

**Summary of the invention.**

It is an object of the present invention to provide an alternative gas burner membrane comprising different combustion zones. Also a method to provide such a gas burner membrane is explained.

25

To provide a gas burner membrane as subject of the invention, textile fabrics comprising metal fibers are provided. Within the context of the present invention, a textile fabric refers to a flexible fabric, comprising fibers and being a woven, braided, knitted or nonwoven structure. It does not refer to sintered metal fiber surfaces, which are not flexible.

30

Over its surface, the textile fabric has at least two zones, which have a different air permeability.

When this textile fabric is used as gas burner membrane, the different zones of the textile fabric provide different combustion zones to the gas burner membrane.

5 A gas burner membrane as subject of the invention comprises at least a basic textile fabric layer. Different zones of the textile fabric with different air permeability may be provided to this basic textile fabric layer according to the present invention, in several different ways.

10 A first gas burner membrane as subject of the invention may be provided by adding one or more additional layers of textile fabric on the basic textile fabric layer at certain zones. The various layers of textile fabric are fixed one to another, preferably by spot welding.

15 An alternative gas burner membrane as subject of the invention is provided using different textile structures to provide the different zones of the textile fabric, with different air permeability.

In case the textile fabric is a woven textile fabric, different textile structures may e.g. be obtained by:

20

- Using locally different warp and/or weft yarns, e.g. using locally finer or coarser yarns, having a different metric number (hereafter referred to as Nm, being length of one gram of yarn);
- 25 ▪ Using locally a different weaving density, e.g. by increasing or decreasing the number of warp and/or weft yarns per length units of the woven textile fabric;
- Using locally a different weaving pattern, e.g. using locally a satin weaving pattern, a rib weaving pattern, a plain weaving
- 30 pattern, or any other weaving pattern.

All this resulting in zones in the textile fabric, having different air permeability, providing different combustion zones to the gas burner membrane.

5        When a knitted textile fabric is provided, the number of yarns, the yarn thickness or the knitting structure may be different in specific zones of the fabric. Also, larger or smaller stitches may be provided locally. All this resulting in zones in the textile fabric having a different air permeability.

10       Another alternative gas burner membrane as subject of the invention is provided by using different yarns to provide the textile fabric, said yarns comprising a different quantity of polymer or natural fibers, next to metal fibers. These yarns may be used to provide a fabric as subject of the invention, e.g. by weaving, braiding or knitting. When Polymer fibers are  
15       removed, e.g. by burning them out of the textile fabric, a fabric consisting of metal fibers is left, which comprises various zones. Each zone has different air permeability, dependent on the quantity of metal fibers left in this zone. Yarns having a core consisting of metal fibers, and comprising polymer fibers which cover partially or fully this core may be used.

20       Alternatively, yarns comprising metal fiber may also comprise ceramic fibers or ceramic fiber yarns. It was found that gas burner membranes, comprising metal fibers and ceramic fibers on its burner surface are more resistant to higher temperatures as compared to 100% metal fiber  
25       gas burner membranes. " Burner surface " is to be understood as the surface of the gas burner membrane, at which side the combustion takes place. At the same time, they are more resistant to mechanical damage as compared to 100% ceramic fiber gas burner membranes. Preferably, a metal fiber yarn is first covered partially or fully with ceramic fibers, e.g.  
30       by wrap spinning of ceramic fiber yarns around the metal fiber. Polymer or natural fibers may then be added to this combination e.g. by wrap spinning or core spinning techniques.

Different types of ceramic fibers may be used to provide the yarns present in the textile fabric for a gas burner membrane as subject of the invention. Ceramic fibers may e.g. be  $\text{Al}_2\text{O}_3$ -based fibers, further comprising  $\text{SiO}_2$ . NEXTEL®-fibers are such fibers which may be used. Ceramic fibers based on  $\text{Al}_2\text{O}_3$  may be used, e.g. fibers comprising 62 % by weight  $\text{Al}_2\text{O}_3$ , 24 % by weight  $\text{SiO}_2$  and 14% by weight  $\text{B}_2\text{O}_3$ . Preferably however,  $\text{SiO}_2$ -based fibers are used, such as QUARTZEL® fibers from Quartz & Silice, which comprises more than 99.99%  $\text{SiO}_2$ .

When ceramic fibers are used, next to metal fibers to provide the textile fabric of the gas burner membrane, preferably more ceramic fibers are used to provide the combustion zones with the lowest air permeability.

When a textile fabric, comprising such zones with different air permeability is used as a gas burner membrane, each zone will provide a specific combustion zone to the gas burner membrane. As a consequence, due to the different air permeability, different amounts of gas flowing through these zones cause different firings rates and provide different combustion zones to the gas burner membrane, and this at a firing load, which is equal for the whole gas burner membrane. "firing load" is to be understood as the volume of combustible gas which is provided to a gas burner membrane surface per time unit. So to say, during combustion, the combustion zones having highest air permeability will preferably provide non-radiant combustion, whereas the zones with lower air permeability preferably provide a radiant combustion. According to the invention, the zones, which are closest to the frame in which the gas burner membrane is mounted, have low air permeability so providing preferably radiant combustion to improve the combustion stability.

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A gas burner membrane as subject of the invention thus may comprise various combustion zones, wherein the zones differ in air permeability due to a number of layers of textile, one on top of the other, or to varying textile structure in the textile fabric.

5

Such a gas burner membrane provides the same benefits as a gas burner membrane as described in US5439372, but does not have the disadvantages of the sintered metal fiber surfaces and includes the advantage of having a very flexible and drapable gas burner membrane.

10

In case various layers of textile fabric are used to provide a gas burner membrane as subject of the invention, possibly but not necessarily, the various layers of textile fabric may be provided out of the same textile fabric. So only one textile fabric, with its specific structure is to be manufactured. Various zones, each with its specific shape or design can be provided just by cutting the surfaces to the various zones out of this fabric and adding them one on top of the other. This provides a very flexible method for designing different gas burner membranes with different zones (as to say custom or tailor made).

15

20

It is clear that different textile fabrics, having a different structure may also provide the various layers. The fact that only one or a small number of different textile structures is to be made in order to be able to manufacture a large type of different combustion zones clearly provides economical advantages.

25

Also in case different textile structures are used locally to provide a textile fabric, a large amount of possibilities are met to design a gas burner membrane with different combustion zones. Designing the textile fabric can be done in such a way that no material is to be cut away before the textile fabric can be used as a gas burner membrane.

30

All type of metal fibers may be used. Fibers obtained by bundle drawing, shaving or cutting action may be used. The equivalent diameter of the metal fibers are usually between 10 and 150  $\mu\text{m}$ , but preferably between 25 and 50  $\mu\text{m}$ , e.g. 25  $\mu\text{m}$ , 30  $\mu\text{m}$  or 35  $\mu\text{m}$ . The metal fibers can be different types of stainless steel, nickel alloys and other specific types of steel containing, for example, chromium, aluminum and/or nickel and 0.05 to 0.3% by weight of yttrium, cerium, lanthanum, hafnium or titanium.

10     **Brief description of the drawings.**

The invention will now be described into more detail with reference to the accompanying drawings wherein

- FIGURE 1 shows a knitting structure, which provides a textile fabric to be used as a textile layer.
- 15     - FIGURE 2 shows a gas burner membrane as subject of the invention comprising various textile layers over its surface.
- FIGURE 3 show another gas burner membrane as subject of the invention comprising different textile structures over its knitted surface.
- 20     - FIGURE 4 shows a gas burner comprising a gas burner membrane as subject of the invention.
- FIGURE 5 show another gas burner membrane as subject of the invention comprising different textile structures over its woven surface.

25

**Description of the preferred embodiments of the invention.**

A knitted textile fabric, to be used as a basic textile fabric layer to provide a gas burner membrane as subject of the invention may be provided by  
30     knitting sets of yarns 11, 12 and 13 according to the knitting structure as shown in FIGURE 1. The fabrics are provided by knitting on a double bed knitting machine, gauge 5 from H. STOLL GmbH & Co. – Reutlingen

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(D), knitted on all needles 14. Three sets of yarn (11, 12 and 13) are knitted consecutive on the front (F) and rear (R) needle bed following the knitting steps I to IV as shown in FIGURE 1. For each yarn group 11, 12 or 13, two yarns of metal fibers are used simultaneously. Each yarn  
5 having a titer of 334 tex, comprise metal fibers of alloy type FECRALLOY®, having a diameter of approximately 25µm. A knitted fabric with thickness of 1.7mm and weight of 1.3 kg/m<sup>2</sup> is provided, having an air permeability of 2100 to 2300 l/dm<sup>2</sup>\*min. This air permeability, like all air permeabilities mentioned in this document, was  
10 measured using a pressure gradient of 200 Pa.

Alternatively, a yarn comprising metal and ceramic fibers is used to provide a basic textile fabric layer. As an example, a yarn is obtained using a bundle of metal fibers, having a titer of 333 tex (333 gram per  
15 kilometer yarn), and being wrapped with a fine PA yarn with titer 156 dtex. This consolidated metal fiber bundle is then wrapped with a ceramic fiber yarn, preferably a ceramic yarn being a ply of two Quartzel®-yarns, each Quartzel® yarn being a plied yarn of two times  
20 120 filaments of 9µm diameter each. The ceramic yarn thus comprises approximately 480 filaments, providing a ceramic yarn of 66 Tex. This ceramic fiber wrapped consolidated metal fiber bundle is then wrapped with polyamid fibers, to provide a yarn which has an outer layer, being substantially provided by this polyamid fibers. The content of such yarn is approximately 63% by weight of metal fiber, 29 % by weight of ceramic  
25 (Quartzel®-) fiber and 8% by weight of polyamid fiber.

As shown in FIGURE 2, a basic textile fabric layer 21 is used, layer 21 being a knitted fabric as provided by the structure of FIGURE 1. Several  
30 strips 22 are cut out of an identical knitted fabric, and spot welded to the basic fabric layer. If required, more than one strip may be added one on top of the other. When this textile fabric with its different zones 23, 24



and 25 is used as a gas burner membrane, each of the zones will have its own firing rate. This since the air permeability in zone 23 is different of the air permeability in zone 24 and 25.

5        Air permeability of 2100 to 2300 l/dm<sup>2</sup>\*min is measured at zone 24, comprising only one layer of the knitted fabric, where an air permeability of 1500 l/dm<sup>2</sup>\*min is measured at zones 23, having two layers of textile fabric an air permeability of 1200 l/dm<sup>2</sup>\*min is obtained in zones 25 having three layers of textile fabric.

10        An alternative is shown in FIGURE 3, where a knitted textile fabric is provided, having different knitting structures over its surface. During the knitting process, a fabric is provided by the knitting sequence as shown in FIGURE 1. During this knitting action, zones 31 are knitted using two  
15        yarns of a titer of 334 tex, comprise metal fibers of alloy type FECRALLOY®, having a diameter of approximately 25µm. Zone 32 is provided using only one of such yarn, whereas zone 33 is provided using three of these yarns. Zones 31 are then obtained having an air  
20        permeability of 2100 to 2300 l/dm<sup>2</sup>\*min, whereas zone 32 has an air permeability of 3000 to 3200 l/dm<sup>2</sup>\*min and zone 33 has an air permeability of 1350 to 1500 l/dm<sup>2</sup>\*min.

25        As shown in FIGURE 4, zones 41 of a gas burner membrane 42 being located closest to the frame 43 in which the gas burner membrane is mounted, provide radiant combustion. Over the surface of the gas burner membrane, different zones 44 and 45 may be located, each  
30        characterized by their specific air permeability and so providing preferably non-radiant or radiant combustion.

30        Another alternative gas burner membrane is shown in FIGURE 5, which comprises a woven basic textile fabric layer 50, having different zones with a different air permeability over its surface. The woven basic textile

5 fabric layer is provided using a plain weaving structure. In weft direction 51, a warp density of seventy-two yarns per 10 cm of textile fabric is used in the zones 52. A warp density of fifty yarns per 10 cm is used to provide zones 53. In warp direction 54, a weft density of twenty-two  
10 yarns per 10 cm of textile fabric is used in the zones 55. A weft density of thirty-two yarns per 10 cm is used to provide zones 56. 4 different zones 57, 58, 59 and 60 are obtained, each zone having an air permeability depending from the warp and weft density in that zone. When this woven basic textile fabric layer is used to provide a gas burner membrane, 4  
15 different combustion zones, each zone related to a zone 57, 58, 59 or 60 of the textile fabric, may be obtained.

15 Preferably, but not necessarily, a yarn comprising metal and ceramic fibers is used to provide the woven basic textile fabric layer. Preferably, the yarn, comprises a bundle of metal fibers, having a titer of 333 tex (333 gram per kilometer yarn), and being wrapped with a fine PA yarn with titer 156 dtex. This consolidated metal fiber bundle is then wrapped with a ceramic fiber yarn, preferably a ceramic yarn being a ply of two  
20 Quartzel®-yarns, each Quartzel® yarn being a plied yarn of two times 120 filaments of 9µm diameter each. The ceramic yarn thus comprises approximately 480 filaments, providing a ceramic yarn of 66 Tex. This ceramic fiber wrapped consolidated metal fiber bundle is then wrapped with polyamid fibers, to provide a yarn which has an outer layer, being substantially provided by this polyamid fibers. The content of such yarn  
25 is approximately 63% by weight of metal fiber, 29 % by weight of ceramic (Quartzel®-) fiber and 8% by weight of polyamid fiber.

**CLAIMS**

- 1 A gas burner membrane comprising a textile fabric, said textile fabric comprising metal fibers, characterized in that said textile fabric comprising more than one zone, at least one of said zones having a different air permeability compared to the other said zones, said zones of said textile fabric providing at least two different combustion zones to said gas burner membrane.
- 5
- 10 2 A gas burner membrane as in claim 1, wherein said textile fabric consists of metal fibers.
- 3 A gas burner membrane as in claim 1, wherein said textile fabric comprises ceramic fibers.
- 15
- 4 A gas burner membrane as in claim 1 or 3, wherein at least one of said combustion zones comprise more than one layer of said textile fabric to provide said different air permeability.
- 20 5 A gas burner membrane as in claim 4, wherein said layers of textile fabric are fixed to each other by spot welding.
- 6 A gas burner membrane as in claim 4 to 5, wherein said layers are of an identical textile structure.
- 25
- 7 A gas burner membrane as in claim 4 to 5, wherein said layers are of a different textile structure.
- 8 A gas burner membrane as in claim 1 to 3, wherein said zones of said textile fabric are provided by a different textile structure.
- 30

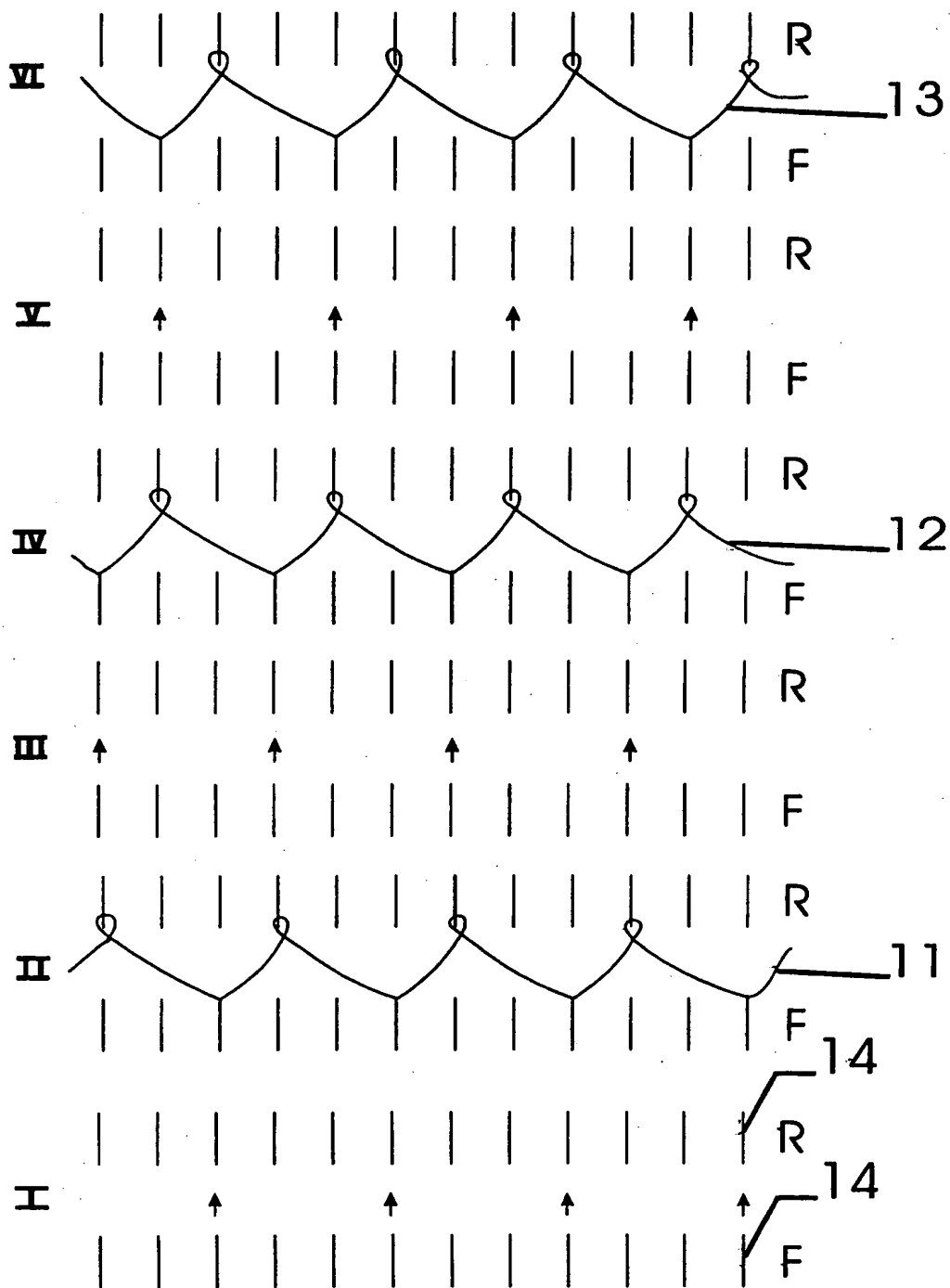
-11-

- 9 A gas burner membrane as in claim 1 to 8, wherein at least one textile fabric is a knitted fabric.
- 5 10 A gas burner membrane as in claim 1 to 9, wherein all textile fabrics are knitted fabrics.
- 10 11 A gas burner membrane as in claims 1 to 10, said gas burner membrane being fixed in a frame, wherein said zones located closest to said frame, having the lowest air permeability compared to the other of said zones.
- 15 12 A method of manufacturing a gas burner membrane, said method comprising the step of providing a textile fabric comprising different zones, said zones being provided by different textile structures.
- 20 13 A method to provide a gas burner membrane, comprising the steps of
- providing textile fabric, said fabric comprising metal fibers;
  - using said textile fabric as a basic textile fabric layer;
  - 25 - adding more than one layer of textile fabrics at one or more zones of said basic textile fabric layer;
  - fixing layers of textile fabric to another;
- 30 14 A method according to claim 12, said method further comprising the step of fixing of said textile fabric layers is done by spot welding.
- 15 Use of a gas burner membrane as in claim 1 to 10 for gas combustion, applying at least two different firing rates simultaneously on said gas burner membrane.

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- 16 Use of a gas burner membrane obtainable by a method as in claim 11 to 13 for gas combustion, applying at least two different firing rates simultaneously on said gas burner membrane.

- 1/3 -

Fig. 1

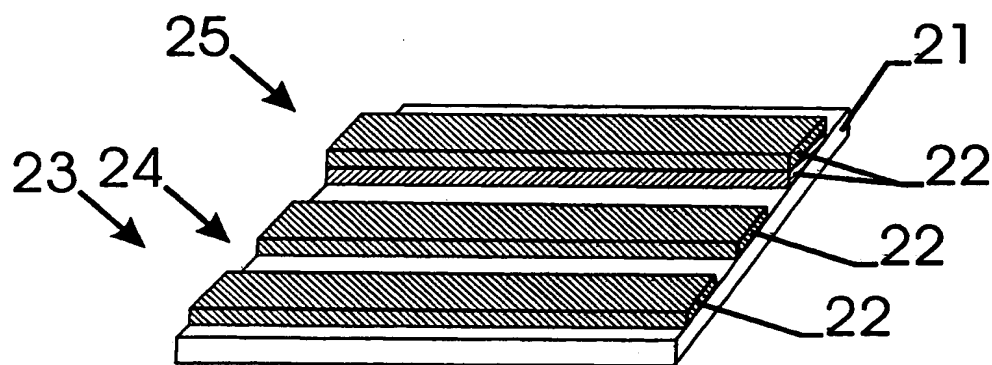


Fig. 2

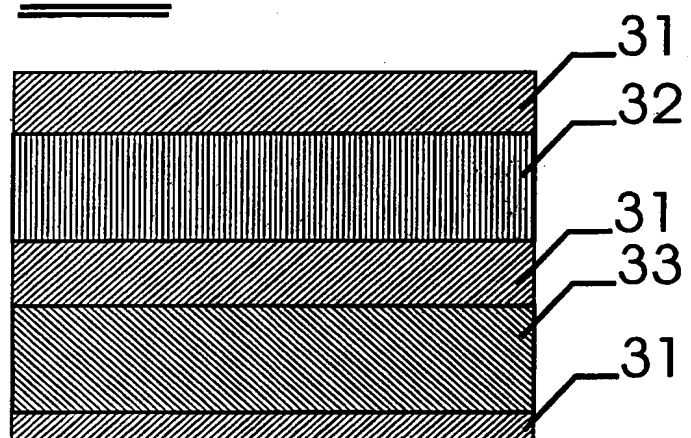


Fig. 3

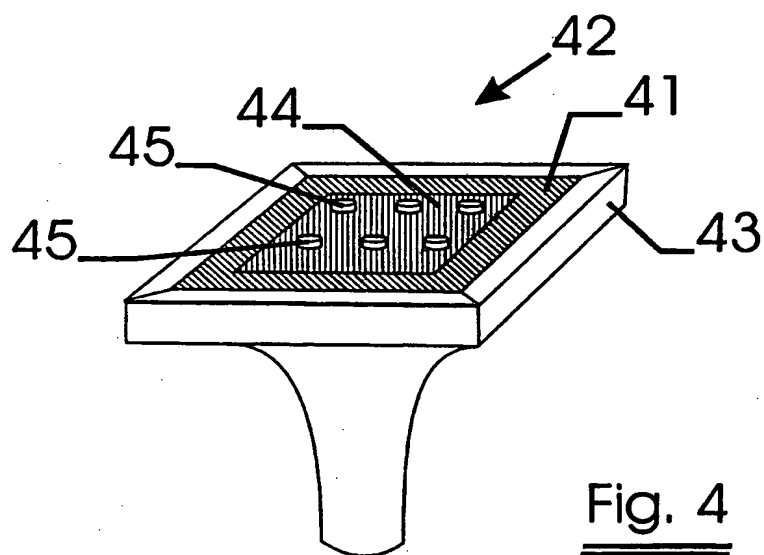
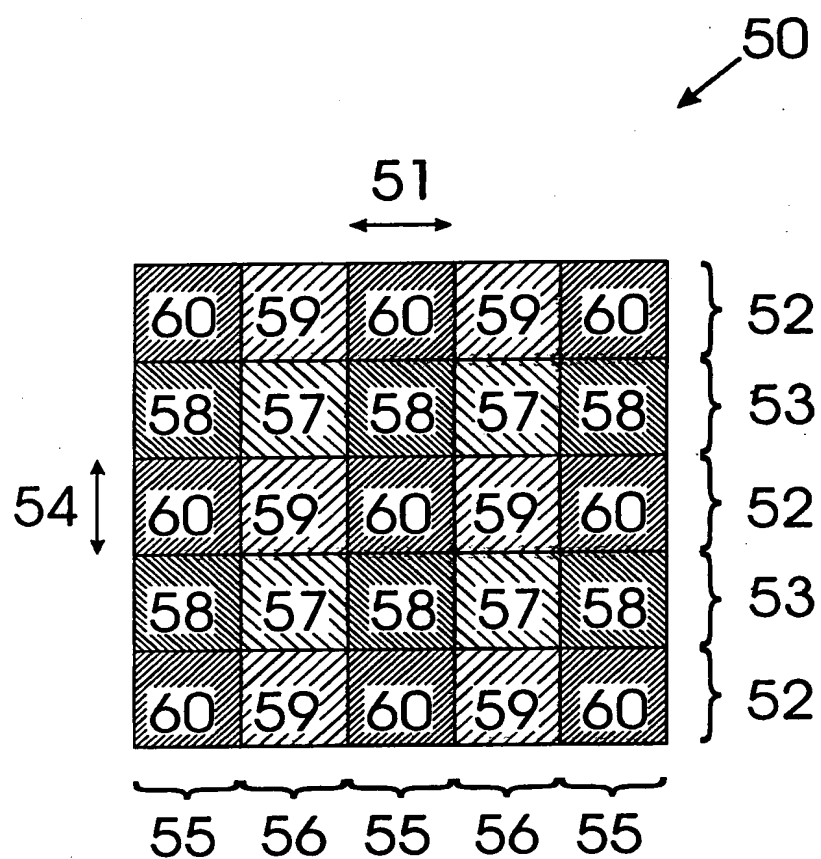


Fig. 4

Fig. 5



## INTERNATIONAL SEARCH REPORT

International Application No.  
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IPC 7 F23D14/14

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F23D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 97 04152 A (BEKAERT SA NV ;DEWAEGHENEIRE GABRIEL (BE); VANSTEENKISTE PHILIP (B) 6 February 1997 (1997-02-06) page 1, line 27 - line 34 page 5, line 7 -page 6, line 29	1,2,9, 12,13, 15,16
A	US 5 800 156 A (KAHLKE MICHAEL ET AL) 1 September 1998 (1998-09-01)  column 2, line 66 -column 4, line 22 figures 1-3	1-4,6-8, 12,13, 15,16
A	US 5 439 372 A (DURET MICHAEL J ET AL) 8 August 1995 (1995-08-08) cited in the application column 3, line 39 -column 4, line 13 figures 1,3	1,12,13, 15,16

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

Automatic Publication No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9704152 A	06-02-1997	BE 1009485 A	01-04-1997
		AT 196326 T	15-09-2000
		CN 1191001 A	19-08-1998
		DE 69610317 D	19-10-2000
		DE 69610317 T	01-03-2001
		EP 0839221 A	06-05-1998
		ES 2152547 T	01-02-2001
		JP 11509278 T	17-08-1999
		US 6025282 A	15-02-2000
US 5800156 A	01-09-1998	DE 4445426 A	27-06-1996
		AU 4047795 A	27-06-1996
		BR 9505936 A	23-12-1997
		EP 0718551 A	26-06-1996
		JP 8219422 A	30-08-1996
US 5439372 A	08-08-1995	AU 7213594 A	17-01-1995
		DE 69426022 D	02-11-2000
		DE 69426022 T	23-05-2001
		EP 0705409 A	10-04-1996
		WO 9500802 A	05-01-1995